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FOUNDRY IRON.

By CAPTAIN HENNING Imperial Artillery, Berlin, Germany.

One of the commonest arguments against chemistry in the foundry is the well known fact that irons with the identical composition may show widely different physical properties, and, similarly, good castings of a given kind may vary considerably in their composition. The importance of this situation makes it imperative to trace the causes for the apparent contradiction.

In every case of this kind which has come to my notice whenever the pig iron showed the proper analysis, the blame has been placed upon the foundry. Poor moulding, cold iron, unequal cooling, abrupt change of section, trouble in the place from which the test pieces were cut or difficulties in making a separate set of test bars, are considered as the primary causes of failure to see predictions carried out. It is also known that the cupola itself has a great influence on results, for with the same mode of operations and material one day's run may be quite different from the other.

My own experience in one foundry has shown me that different shipments of one brand of iron, in spite of a practically identical composition, may produce quite different results and that the foundry will not be to blame therefor. This particular foundry was accustomed to work so painfully exact that the conclusion was forced upon all of those interested that the root of the evil was to be looked for in the blast furnace. It is a well understood fact that even with the most uniform burden a blast furnace cannot make absolutely uniform pigs so far as their composition is concerned, yet the end product will be comparatively more homogeneous than a cupola process could make it, for the quantities are much larger and the process is a continuous one. If, now, the greatest care is taken in running the cupola, and handling the moten metal, the unavoidable differences in compo-

sition in the castings made will be found to be quite unimportant if only the same care is taken with the burden in the blast furnace.

With a pig iron thus carefully made I have had no trouble whatever in producing a perfectly satisfactory run of castings where the composition ranged from 3.50 to 3.75 total carbon, 0.27 to 0.52 combined carbon, 2.62 to 3.22 silicon, 0.98 to 1.18 manganese, .60 phosphorus, .03 sulphur and .02 copper. The mixtures were naturally regulated very carefully with reference to pig and scrap. The percentage of impurities ranged from 7.50 to 8.10%, the iron running 92.475% on an average. Whenever the percentage of impurities exceeded 8.0, sending the iron below 92.%, the castings would become undesirable, porous, and weak. When the impurities reached 9% and over, (I have sometimes had 9.36%, which meant that the iron dropped below 91.%) the castings were unfit for use.

In my estimation the above limits are not absolutely final ones, for circumstances may circumscribe them much more closely. That the quality of the castings must suffer when the percentage of impurities rises is perfectly natural, but even with the same percentage of iron present, as for instance, 92.475, as given above, or 92.22%, as in another case where the impurities were 7.78, the difficulties may be greatly increased when any particular impurity goes up unduly. For instance, sulphur and copper may be too high, manganese, silicon and carbon too low.

Where the same brand of iron was used continuously and the quality of the castings gradually deteriorated in spite of a proper pig iron composition, the answer was more difficult. The determination of the iron contents finally solved it. This was found to have gradually dropped from 92.475% down to 91.0% and even below, and resulted from changes in the furnace burden. It was found that in the hope of improving the pig iron for foundry purposes and getting a specially fine fracture the carbon was brought up to 4.%, the silicon from 4.10 to 4.34%, manganese to 1.23%, phosphorus 0.6%, sulphur .055%, and copper from .02 to .10%.

As I know of pig irons which are sold as among the best and still contain 4.9% total carbon, silicon 2.0 to 2.50%, manganese .6 to.7%, phosphorus .94 to 1.20%, and sulphur 0.10 to 0.14%, it is not to be wondered that the results would be poor. Where the

percentage of iron is dropped down to 89.65% instead of being 92.%, castings must be failures. The tendency of German furnaces is to burden the furnace to produce a maximum amount of silicon. The result is a maximum of other things not so desirable, and the complaints heard so often about bad iron are fully justified.

The trouble with furnace men seems to be the all too frequent practice of using mill cinder in the burden. This of course promotes smoother running on the part of the furnace, helps to avoid explosions and cheapens the run. If this slag and cinder is added judiciously it certainly helps the foundryman, but how few of them exercise the necessary care. My own experience indicates that irons made with the use of plenty of cinder for washing purposes furnish a foundry pig iron which is unreliable, weak, and of very little value for critical work when compared with the "honest" pig irons.

From the above remarks we will see that chemical and physical investigations are of great value to the foundry industry and that the same class of investigations are equally necessary at the blast furnace if good results are to follow regularly.

For a proper exchange of opinions and for purposes of record all chemical and physical investigations should be conducted on standard lines. Uniformity in test bars and methods of analysis is very essential not only where simple information is wanted, but also for trade purposes. Fortunately Europe and America are working hand in hand in this direction.

If, as it seems, there is a general demand on the part of consumers to get a better grade of castings, be it through an improvement of the cupola product or in the original pig irons used, this demand will have to be satisfied or attention will be turned in a still greater measure to furnace iron and steel castings. A comparison of the analyses mentioned above with those which follow will show this.

Cold blast charcoal iron usually runs 3.00 to 3.50% carbon, .60 to 2.00 silicon, .40 to 1.00 manganese, .15 to .25 phosphorus, and .02 to .04 sulphur, or 4.17 to 6.97% impurities and 95.83 to 93.21% iron. Compared with the pig irons discussed in the early part of this paper a marked improvement may be readily seen. Steel castings similarly show only .74 to 1.44% impurities and 99.86 to 98.56% iron. It is evident that coke irons as now produced show

a tendency to slip through altogether too great a percentage of impurities, and indeed America has recognized this fact by an enormous expansion of its steel casting industry.

In closing this article I beg to acknowledge the disinterested kindness and assistance rendered me by the management of the Zawadyki Foundry, by General Manager Esser, of the Upper Silesian R. R. Co., and the laboratories of Dr. Carl Heyer in Dessau.